Activation Indicators

	Handswitching	Footswitching	Activation Indicator
Bipolar	Close forceps tines firmly	Press pedal	Activation tone sounds – Bipolar indicator illuminates blue
Monopolar	Press Cut or Coag button or Close forceps tines firmly	Press Cut or Coag pedal	Activation tone sounds – Cut indicator illuminates yellow or Coag indicator illuminates blue
CUSA handpiece with CEM nosecone	Press Cut or Coag button on CEM nosecone	Press Cut or Coag pedal	Activation tone sounds – Cut indicator illuminates yellow or Coag indicator illuminates blue – CEM indicator on front panel illuminates green when handpiece is properly connected

Periodic Safety Check

Important

When testing RF equipment, follow these test procedures to duplicate manufacturer test data. Keep test leads to the minimum length usable; lead inductance and stray capacitance can adversely affect readings. Carefully select suitable ground points to avoid ground loop error in measurements.

The accuracy of most RF instruments is approximately 1–5% of full scale. Using uncompensated scope probes causes large errors when measuring high voltage RF waveforms.

Perform the following safety check every six months to verify that the generator is functioning properly. Record the test results for reference in future tests. If the generator fails to meet any of the checks, refer to Chapter 6, *Troubleshooting*.

Warning

Electric Shock Hazard When taking measurements or troubleshooting the generator, take appropriate precautions, such as using isolated tools and equipment, using the "one hand rule," etc.

Electric Shock Hazard Do not touch any exposed wiring or conductive surfaces while the generator is disassembled and energized. Never wear a grounding strap when working on an energized generator.

Caution

The generator contains electrostatic-sensitive components. When repairing the generator, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized generator. Handle circuit boards by their nonconductive edges. Use an antistatic container for transport of electrostatic-sensitive components and circuit boards.

Here is a summary of safety checks:

- Inspect the generator and accessories
- Inspect the internal components
- Test the generator
- Verify REM function
- Confirm outputs
- Check leakage current and ground resistance

Recommended Test Equipment

- Digital voltmeter—Fluke 77 or 87, or equivalent
- True RMS voltmeter—Fluke 8920, or equivalent
- Oscilloscope—Tektronix 2445, or equivalent
- Leakage current tester—Use UL load device or commercially available leakage tester
- Leakage table—per IEC 60601-2-2, Figure 104
- 100, 200, 300, 500 Ω, all 250 watt, 1% tolerance, noninductive (Dale NH-250 or equivalent)

Inspecting the Generator and Accessories

Equipment required

- Bipolar footswitch or monopolar footswitch
- Bipolar instrument cords (handswitching and footswitching)
- Monopolar instrument cords (handswitching and footswitching)

Turn off the generator, and disconnect the power cord from the wall receptacle.

Rear Panel

1. Check the rear panel footswitch receptacles for obstructions or damage. Check for a secure fit by inserting the bipolar footswitch or monopolar footswitch connector into the appropriate receptacle.
2. Remove the fuse and verify correct voltage and current rating. Refer to *Performance Characteristics* on page 3-2.

If either connection is loose, replace the Footswitch board assembly. Refer to *Footswitch Board Replacement* on page 7-8.

Front Panel

1. Check the Bipolar Instrument receptacle for obstructions or damage. Insert the bipolar instrument connector (footswitching and handswitching) into the appropriate receptacle to verify a secure fit.

   If the connection is loose, replace the front panel assembly. Refer to *Front Panel Replacement* on page 7-9.
2. Check the monopolar instrument receptacles for obstructions or damage. Insert the monopolar instrument connector (footswitching and handswitching) into the appropriate receptacle to verify a secure fit.

   If any of the connections are loose, replace the front panel assembly. Refer to *Front Panel Replacement* on page 7-9.
3. Check the Patient Return Electrode receptacle for a broken pin or an obstruction. If the receptacle is damaged or obstructed, replace the front panel assembly. Refer to *Front Panel Replacement* on page 7-9.

Footswitch

1. Disconnect the footswitch from the generator.
2. Disassemble the footswitch connector. Inspect the connector for damage or corrosion.
3. Reassemble the footswitch connector.

4. Inspect the footswitch for damage.
5. Reconnect the footswitch to the generator.

Power Cord

1. Disconnect the power cord from the unit and ensure that it is unplugged from the wall receptacle.
2. Inspect the power cord for damage.
3. Reconnect the power cord to the generator and wall receptacle.

Inspecting the Internal Components

Equipment required

- Phillips screwdriver

Caution

The generator contains electrostatic-sensitive components. When repairing the generator, work at a static-control workstation. Wear a grounding strap when handling electrostatic-sensitive components, except when working on an energized generator. Handle circuit boards by their nonconductive edges. Use an antistatic container for transport of electrostatic-sensitive components and circuit boards.

1. Turn off the generator.
2. Loosen the five screws that secure the cover to the chassis. Lift the cover off the chassis. Set the cover aside for reinstallation.
3. Verify that all connectors are firmly seated.
4. Inspect each board for damaged components, wires, cracks, and corrosion.
   - If you find evidence of damage on the Control board, Display board, or Footswitch board, replace the board. Refer to *Control Board Replacement* on page 7-4, *Display Board Replacement* on page 7-5, or *Footswitch Board Replacement* on page 7-8.
   - If you find evidence of damage on the Power Supply/RF board, replace the board only if the damage is severe. Refer to *Power Supply/RF Board Replacement* on page 7-26.
5. Reinstall the cover on the generator. Position the cover above the chassis and slide it down. Tighten the five screws that secure the cover to the chassis.

Testing the Generator

Turning on the generator initiates an internal self-test to verify the calibration. The self-test also checks the operation of the speaker, all indicators, and the displays.

Warning

Use the generator only if the self-test has been completed as described. Otherwise, inaccurate power outputs may result.

Generator Self-test

1. Turn on the generator by pressing the front panel On (|) switch. Verify the following:

- All visual indicators and displays on the front panel illuminate.
- Activation tones sound to verify that the speaker is working properly.

Important

If the coag mode has been optionally changed to default to Desiccate or Spray, that corresponding indicator illuminates after the self-test is performed successfully.

2. **If the self-test is successful,** a tone sounds. Verify the following:

- Indicators above the default mode buttons (Standard bipolar, Pure cut, and Fulgurate coag) illuminate green.
- Each display shows a power setting of one watt.
- The REM Alarm indicator illuminates red.

If the self-test is not successful, an alarm tone sounds. A number may momentarily appear in the Cut display and, in most cases, the generator is disabled. Note the number and refer to *Responding to System Alarms* on page 6-11.

If you removed and/or replaced the battery, alarm number 212 may appear in the Cut display when you turn on the generator. If this happens, calibrate the generator.

Verifying REM Function

Equipment required

REM plug and resistance substitution box.

1. Set the resistance substitution box to 120 Ω. Connect the resistance box to the generator and confirm that the REM indicator illuminates green.
2. Slowly increase the resistance and verify that the REM alarm sounds at 135 ± 5 Ω.
3. Decrease the resistance to 60 Ω and verify that the REM indicator illuminates green.
4. Increase the resistance to 100 Ω and verify that the REM alarm sounds.
5. Decrease the resistance to 30 Ω and verify that the REM indicator illuminates green.
6. Decrease the resistance to 10 Ω and verify that the REM indicator illuminates green.
7. Decrease the resistance to 3 Ω and verify that the REM alarm sounds.
8. Switch to a connector without the pin, and increase the resistance from 3 Ω to 24 Ω. Verify that the REM alarm sounds.

Confirming Outputs

Use this procedure to ensure the accuracy of the generator. Always confirm the output:

- After calibrating the generator
- Every six months

Equipment required

- Two small test cables (less than 24" [61 cm] long) with banana plugs
- Current transformer
- True RMS voltmeter (such as the Fluke 8920 or equivalent)
- 100, 300, and 500 Ω 1% noninductive power resistors
- Bipolar footswitch and monopolar footswitch

Checking the Bipolar Output

1. Verify that the generator successfully completes the self-test as described in *Generator Self-test* on page 5-18 in this section.
2. Connect the test equipment for bipolar output.
   a. Connect the two test cables to the Bipolar Instrument receptacle.
   b. Pass one test cable through the current transformer and connect the current transformer to the voltmeter.

c. Connect the 100 Ω power resistor across the output jacks at the end of the test cables.

d. Connect the bipolar footswitch to the Bipolar Footswitch receptacle on the rear panel.

3. Press the Precise button and set the bipolar power to 10 W.

4. Test the output current for the selected Bipolar mode.

a. Press the footswitch pedal and, while activating the generator, note the output on the voltmeter.

b. Release the footswitch pedal.

c. Based on the voltmeter setting and the current transformer you are using, calculate and record the output current.

5. Press the Standard button and repeat step 4 (above).

6. Press the Macro button and repeat step 4 (above).

7. Verify that the generator output for each mode is 315 ± 24 mA_{rms}.

If the output is outside the specified range, calibrate the bipolar output as described in *Calibrating the Generator* on page 5-26. Then repeat this procedure. If the output for one or more modes remains outside the specified range, call the Covidien Service Center.

Checking Output for the Monopolar Cut Modes

1. Verify that the generator successfully completes the self-test as described in *Generator Self-test* on page 5-18.

2. Connect the test equipment for monopolar output.

a. Connect one test cable to the left jack in the Monopolar 1/CEM Instrument receptacle. Pass the test cable through the current transformer and connect the current transformer to the voltmeter.

b. Use a test cable to short the two pins on the Patient Return Electrode receptacle.

c. Connect the second test cable from the voltmeter to both pins of the Patient Return Electrode receptacle.

d. Connect the 300 Ω resistor across the output jacks at the end of the test cables.

e. Connect the monopolar footswitch to the Monopolar 1 Footswitch receptacle on the rear panel of the generator.

3. Press the Pure button.

4. Press the Cut up (Δ) or down (∇) arrow buttons to set the cut power to 75 W.

5. Test the monopolar cut output.

a. Press the footswitch cut pedal and, while activating the generator, note the output on the voltmeter.

b. Release the footswitch pedal.

c. Based on the voltmeter setting and the current transformer you are using, calculate and record the output current.

6. Press the Low cut button and repeat step 5 (above).

7. Press the Blend button and repeat step 5 (above).

8. Verify that the generator output for each mode is 499 ± 38 mA_{rms}.

If the output is outside the specified range, calibrate the monopolar output as described in *Calibrating the Generator* on page 5-26. Then repeat this procedure. If the output for one or more cut modes remains outside the specified range, call the Covidien Service Center.

Checking Output for the Monopolar Coag Modes

1. Complete steps 1 and 2 of *Checking Output for the Monopolar Cut Modes* on page 5-20, replacing 300 Ω resistor with 500 Ω resistor in item 2d.
2. Press the Low (Desiccate) button.
3. Press the Coag up (Δ) or down (∇) arrow buttons to set the coag power to 30 W.
4. Test the monopolar coag output.
   a. Press the footswitch coag pedal and, while activating the generator, note the output on the voltmeter.
   b. Release the footswitch pedal.
   c. Based on the voltmeter setting and the current transformer you are using, calculate and record the output current.
5. Press the Med (Fulgurate) button and repeat step 4 (above).
6. Press the Med (Fulgurate) button and hold for two seconds. After the tone sounds and the "L" appears on the left side of the Coag display, repeat step 4 (above).
7. Press the High (Spray) button and repeat step 4 (above).
8. Verify that the generator output for each mode is 245 ± 19 mA_{rms}.

   If the output is outside the specified range, calibrate the monopolar output as described in *Calibrating the Generator* on page 5-26. Then repeat this procedure. If the output for one or more coag modes remains outside the specified range, call the Covidien Service Center.

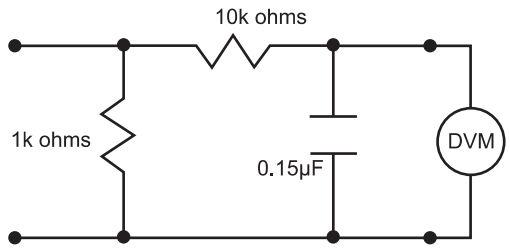
Checking Low Frequency Leakage Current and Ground Resistance

Check the low frequency leakage current and ground resistance before returning the generator to clinical use.

Equipment required

- DVM
- Leakage current tester

Leakage current test circuit per IEC 60601-1



1 millivolt = 1 microamp

Output Receptacles and REM Source Current

1. Set the DVM to AC volts (200 millivolts [mV]) and connect the leakage current test circuit.
2. Turn on the generator.
3. Measure between all the output receptacles (including the Patient Return Electrode receptacle) and earth ground. Record the largest reading.
4. Determine the leakage current using the conventional 1 microamp (µA) per 1 mV.
5. Verify under normal conditions (ground closed, normal polarity) the leakage current is less than 10 µA. If the leakage current is greater than 10 µA, call the Covidien Service Center.
6. Verify single fault conditions (ground open) the leakage current is less than or equal to 50 µA. If the leakage current is greater than 50 µA, call the Covidien Service Center.

Chassis or Earth Leakage

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the generator.
3. Measure between the chassis and earth ground.
4. Determine the leakage current using the conventional 1 µA per 1 mV.
5. Verify under normal conditions (ground closed, normal polarity) the leakage current is less than 100 µA. If the leakage current is greater than 100 µA, call the Covidien Service Center.
6. Verify single fault conditions (ground open) the leakage current is less than or equal to 300 µA. If the leakage current is greater than 300 µA, call the Covidien Service Center.

Output Receptacles and REM Sink Current

1. Set the DVM to AC volts (200 mV) and connect the leakage current test circuit.
2. Turn on the generator and connect the end of the leakage current test circuit to mains voltage through a 120 kΩ resistor.
3. Connect the other side of the IEC leakage load to all of the output receptacles (including the Patient Return Electrode receptacle).
4. Determine the leakage current using the conventional 1 µA per 1 mV.
5. Verify the leakage current is less than or equal to 20 µA. If the leakage current is greater than 20 µA, call the Covidien Service Center.

Checking High Frequency Leakage Current

Check the high frequency leakage current and ground resistance before returning the generator to clinical use. Check the leakage current:

- After calibrating the generator
- Every six months

Equipment required

- 200 Ω, 250 watt, noninductive resistor
- Current transformer
- True RMS voltmeter (Fluke 8920 or equivalent)
- Bipolar and monopolar footswitches
- Leakage table - per IEC 60601-2-2, Figure 104.

Checking Monopolar High Frequency Leakage Current

1. Connect the 200 Ω load from the active accessory through the current transformer to the equipotential ground lug on the rear of the generator.
2. Connect the current transformer to a true RMS voltmeter.
3. Connect a monopolar footswitch to the Monopolar 1 Footswitch receptacle on the rear panel.
4. Activate the footswitch in each Monopolar mode at the maximum control setting. Record the leakage current. If using the leakage table, leakage current should not exceed 150 mA for any mode.
5. If the high frequency leakage exceeds 150 mA, call the Covidien Service Center for further instructions.

Checking Bipolar High Frequency Leakage Current

1. Remove the monopolar accessories, and connect the 200 Ω load from one side of the bipolar output through the current transformer to the equipotential ground lug on the rear of the generator.
2. Connect the current transformer to the true RMS voltmeter.
3. Connect a bipolar footswitch to the Bipolar Footswitch receptacle on the rear panel.
4. Activate the footswitch in each mode at maximum control setting. Record the leakage current. It should not exceed 60 mA for any mode using either the leakage table or short lead configuration.
5. If the high frequency leakage exceeds 60 mA, call the Covidien Service Center for further instructions.